

PRELIMINARY DATA SUMMARY

January 1992

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

## PRELIMINARY DATA SUMMARY

CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

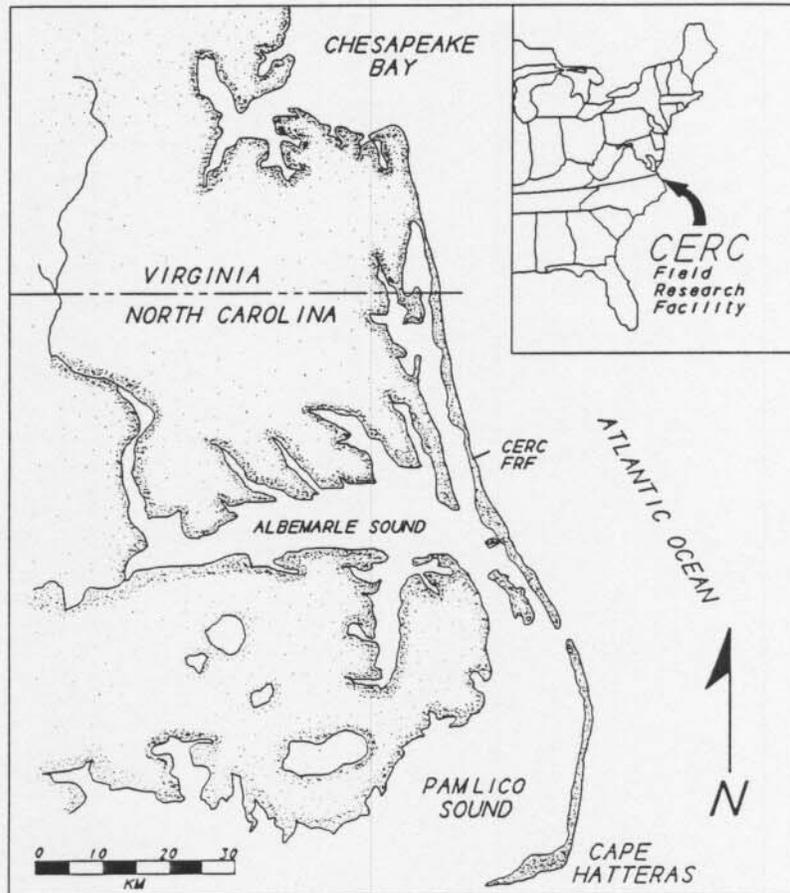
One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).





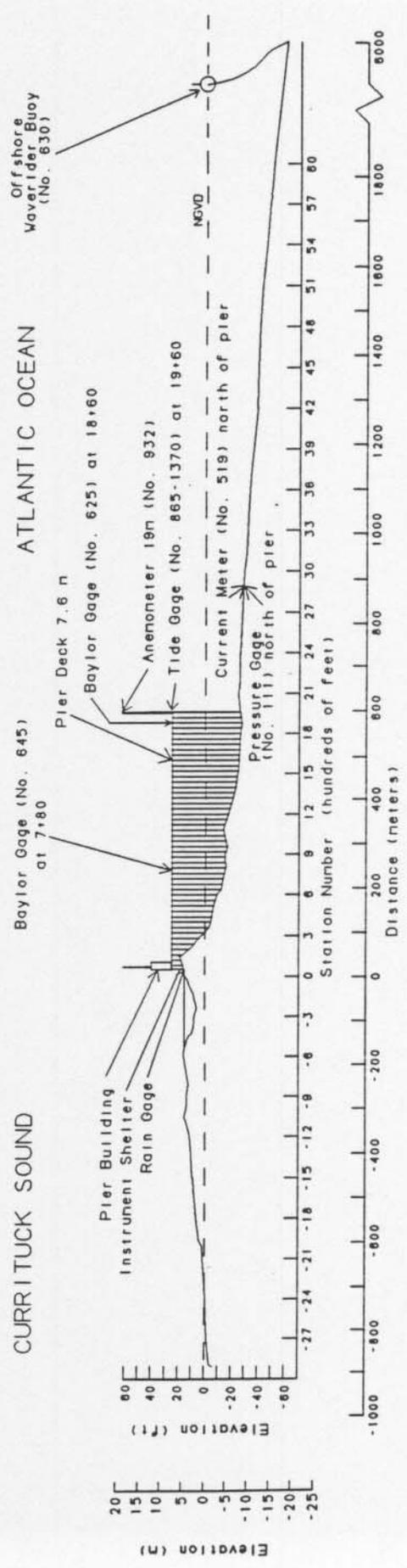
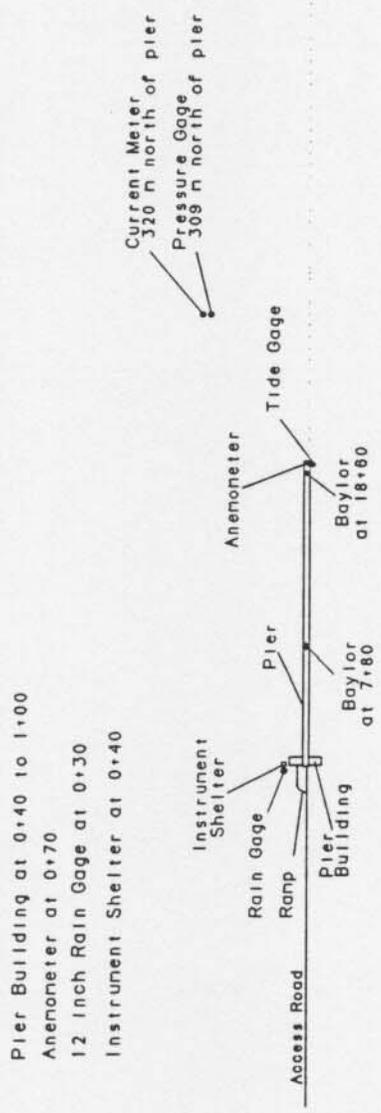


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

## PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -  
 $\text{mm} \times .03937 = \text{in.}$
2. Millibars (mb) to inches of mercury (in. Hg) -  
 $\text{mb} \times 0.02953 = \text{in. Hg}$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -  
 $(\text{C} \times 9/5) + 32 = \text{F}$
4. Meters per second (m/s) to knots (kn) -  
 $\text{m/s} \times 1.943 = \text{kn}$

Table 2: Meteorological Data

Jan 1992

Day	Hour	Wind Speed	Wind Direction	Temperature	Atm Pressure	Precipitation
		m/sec	deg TN	deg C	mb	mm
1	100	8	33	9.3	1028.1	0
	700	7	7	9.5	1028.7	0
	1300	7	14	10.7	1027.9	0
	1900	4	3	10.0	1027.4	0
2	100	6	357	9.6	1026.0	0
	700	5	4	10.0	1024.6	0
	1300	6	66	11.7	1021.3	0
	1900	9	76	11.9	1019.1	0
3	100	7	81	11.5	1015.8	0
	700	9	82	11.8	1012.1	0
	1300	10	76	12.4	1005.6	0
	1900	11	69	15.7	1002.1	12
4	100	8	14	14.8	995.8	6
	700	5	235	14.2	996.0	27
	1300	4	248	13.7	998.8	0
	1900	1	247	11.5	1001.7	0
5	100	2	3	10.8	1001.1	0
	700	12	357	10.1	1003.6	0
	1300	13	354	9.8	1005.1	0
	1900	6	333	10.2	1006.8	0
6	100	8	334	7.4	1008.2	0
	700	3	314	6.3	1009.5	0
	1300	1	30	7.9	1008.5	0
	1900	1	38	7.9	1009.2	0
7	100	5	328	6.3	1010.0	0
	700	11	2	5.7	1013.9	0
	1300	7	1	7.3	1016.1	0
	1900	1	321	3.7	1017.7	0
8	100	3	322	5.1	1019.1	0
	700	6	16	6.2	1021.3	0
	1300	3	36	7.9	1021.6	0
	1900	3	119	6.7	1021.7	0
9	100	4	170	6.7	1019.3	0
	700	3	162	8.9	1016.6	0
	1300	4	259	13.6	1012.0	0
	1900	5	202	16.0	1009.5	0
10	100	4	250	14.8	1006.9	0
	700	4	317	14.0	1006.8	0
	1300	4	348	10.6	1003.8	0
	1900	3	339	9.4	1005.6	0
11	100	9	298	5.9	1008.2	3
	700	7	309	3.3	1012.9	0
	1300	4	300	8.4	1013.0	0
	1900	3	265	7.1	1016.2	0
12	100	3	219	5.8	1017.2	0
	700	3	21	4.5	1019.6	0
	1300	3	142	11.4	1018.9	0
	1900	3	181	9.0	1017.7	0
13	100	4	206	10.7	1014.9	0
	700	2	225	14.9	1013.3	0
	1300	3	203	15.4	1009.9	0
	1900	9	182	15.7	1006.7	0
14	100	6	157	12.4	1000.0	0
	700	11	179	19.7	992.9	0
	1300	11	233	18.8	988.3	0
	1900	12	279	12.4	997.0	0
15	100	8	291	5.3	1005.7	0
	700	9	331	2.3	1012.4	0
	1300	5	330	3.4	1012.9	0
	1900	3	254	3.3	1012.9	0
16	100	9	242	3.4	1008.1	0
	700	14	293	1.3	1007.8	0
	1300	12	300	-0.6	1012.8	0
	1900	9	286	-2.4	1017.9	0

\* electronic problems

(Continued)

(Sheet 1 of 2)

Table 2: Meteorological Data

Jan 1992						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	7	262	-0.4	1018.1	0
	700	8	225	0.7	1015.2	0
	1300		Hardware Error			0
	1900	8	240	6.4	1011.1	0
18	100	5	256	5.0	1013.1	0
	700	4	303	3.4	1015.9	0
	1300	2	21	7.5	1015.9	0
	1900	2	228	4.7	1016.5	0
19	100	11	11	3.8	1019.4	0
	700	11	9	-0.4	1023.3	0
	1300	8	3	-1.7	1023.7	0
	1900	4	321	-3.0	1023.2	0
20	100	0		-3.6	1020.5	0
	700	2	230	-1.6	1017.6	0
	1300	9	255	5.5	1012.6	0
	1900	1	266	2.6	1013.9	0
21	100	2	276	1.2	1015.3	0
	700	2	269	0.2	1016.3	0
	1300	6	250	8.7	1014.9	0
	1900	3	245	7.5	1016.1	0
22	100	5	222	5.9	1016.9	0
	700	3	249	4.1	1019.2	0
	1300		Hardware Error			0
	1900	6	112	8.4	1019.8	0
23	100	2	59	9.9	1015.8	0
	700	6	187	15.5	1011.3	0
	1300	17	177	17.1	1001.8	6
	1900	10	203	16.0	997.7	27
24	100	9	232	12.3	997.5	0
	700	6	272	7.8	1003.1	0
	1300	11	255	9.1	1002.9	0
	1900	11	276	5.9	1011.0	0
25	100	9	298	0.2	1018.8	0
	700	5	297	-1.0	1023.5	0
	1300	2	252	4.1	1022.0	0
	1900	9	170	2.9	1017.9	0
26	100	8	225	6.4	1014.5	0
	700	10	329	3.3	1021.3	0
	1300	12	1	3.5	1026.0	0
	1900	8	21	2.8	1029.7	0
27	100		Hardware Error			19
	700					0
	1300	2	61	7.4	1028.5	0
	1900	4	66	7.5	1026.4	0
28	100	5	4	8.8	1023.9	0
	700	6	19	10.5	1023.4	13
	1300	8	18	9.4	1021.1	4
	1900	9	7	8.3	1021.6	0
29	100	8	12	7.7	1021.6	0
	700	8	3	7.3	1021.9	0
	1300	5	2	6.5	1021.5	0
	1900	0		3.6	1020.8	0
30	100	2	199	2.7	1019.3	0
	700	4	209	5.3	1017.1	0
	1300	5	198	10.0	1013.4	0
	1900	6	208	8.8	1009.7	0
31	100	4	228	7.5	1006.4	0
	700	5	273	6.7	1003.4	0
	1300	4	288	10.4	1000.6	0
	1900	10	6	7.3	1003.4	0
		<u>Resultant</u>		<u>Mean</u>	<u>Mean</u>	<u>Total</u>
		2	309	7.6	1013.7	117

\* electronic problems

(Sheet 2 of 2)

### PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for five contiguous 34-min records.

Wave height  $H_{m0}$  is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period  $T_p$  is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to optical disc.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all  $H_{m0}$  and  $T_p$  values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Jan 1992

Day	Hour	645		625		111		630	
		Baylor Hmo,m	at 7+80 T,sec	Baylor Hmo,m	at 18+60 T,sec	Pressure Gage Hmo,m	T,sec	Offshsr Hmo,m	Wvrdr T,sec
1	0100	1.49	12.19	2.01	11.64	1.99	11.64		
	0700	1.47	6.56	1.77	6.56	1.79	12.19		
	1300	1.00	5.82	1.55	11.64	1.64	11.64		
	1900	1.12	5.57	1.25	12.19	1.37	11.64		
2	0100	0.87	12.19	1.33	10.67	1.36	10.24		
	0700	1.05	5.57	1.11	11.64	1.12	11.64		
	1300	0.76	5.22	1.10	11.13	1.09	8.83		
	1900	1.16	8.26	1.42	8.26	1.45	8.83		
3	0100	0.82	8.83	1.69	8.83	1.79	8.53		
	0700	1.33	8.83	1.92	9.14	1.98	8.83		
	1300	1.15	9.48	2.65	9.85	2.65	9.85		
	1900	1.64	12.19	3.38	11.13	3.86	11.13		
4	0100	1.61	13.47	3.19	11.64	3.87	12.80		
	0700	1.85	14.22	3.61	14.22	4.04	14.22		
	1300	1.61	14.22	3.03	14.22	3.32	14.22		
	1900	1.89	13.47	3.17	13.47	3.20	12.80		
5	0100	1.55	12.80	2.43	12.80	2.75	12.19		
	0700	2.00	12.19	2.17	12.19	2.24	12.19		
	1300	1.60	12.19	2.25	11.64	2.24	11.64		
	1900	1.72	11.13	1.91	11.13	1.87	11.64		
6	0100	1.15	11.64	1.52	11.64	1.69	10.67		
	0700	1.14	11.64	1.46	12.19	1.60	11.64		
	1300	0.74	11.64	1.17	11.13	1.34	11.13		
	1900	0.85	10.24	1.00	11.13	1.16	11.13		
7	0100	0.45	12.19	0.90	11.64	0.93	11.13		
	0700	1.18	5.12	1.26	5.02	1.25	4.92		
	1300	0.68	5.69	1.11	5.82	1.16	5.69		
	1900	0.80	5.12	0.99	6.24	1.03	6.09		
8	0100	0.29	11.64	0.75	9.85	0.74	10.67		
	0700	0.79	4.57	0.94	5.95	0.90	5.45	Gage	Inoperative
	1300	0.42	5.45	0.97	6.92	0.97	7.11		
	1900	0.43	4.20	0.88	6.56	0.93	6.56		
9	0100	0.26	9.48	0.63	7.31	0.63	6.40		
	0700	0.33	8.83	0.53	8.83	0.60	6.56		
	1300	0.19	8.83	0.44	9.14	0.43	9.14		
	1900	0.21	8.83	0.41	14.22	0.45	14.22		
10	0100	0.49	6.74	0.44	14.22	0.48	6.56		
	0700	0.49	7.31	0.38	7.53	0.43	7.53		
	1300	0.50	8.83	0.38	8.53	0.45	8.53		
	1900	0.35	8.53	0.45	8.83	0.48	9.14		
11	0100	0.48	8.83	0.45	9.14	0.38	8.83		
	0700	0.46	5.45	0.65	5.45	0.63	5.45		
	1300	0.78	5.57	0.83	5.57	0.88	6.40		
	1900	0.31	4.41	0.77	7.31	0.77	6.92		
12	0100	0.45	6.74	0.61	6.92	0.68	7.31		
	0700	0.19	9.14	0.55	6.40	0.55	6.40		
	1300	0.45	8.53	0.55	8.53	0.53	9.14		
	1900	0.28	9.14	0.55	9.48	0.56	8.83		
13	0100	0.40	8.83	0.52	8.83	0.55	9.14		
	0700	0.17	8.83	0.38	8.53	0.43	8.83		
	1300	0.37	6.56	0.35	8.26	0.41	9.48		
	1900	0.29	6.74	0.40	9.85	0.43	7.31		
14	0100	0.51	7.31	0.44	7.31	0.47	7.11		
	0700	0.87	8.53	0.82	8.83	0.88	7.53		
	1300	0.85	6.74	0.64	8.00	0.68	6.92		
	1900	0.39	11.13	0.53	10.67	0.51	11.13		
15	0100	0.83	4.92	0.75	5.57	0.77	5.57		
	0700	0.71	5.22	0.94	4.92	1.01	5.12		
	1300	1.03	6.09	1.15	6.09	1.14	6.09		
	1900	0.46	5.33	0.67	6.74	0.72	6.40		
16	0100	0.26	8.26	0.38	8.83	0.43	10.24		
	0700	0.19	3.33	0.47	9.48	0.39	3.24		
	1300	0.78	5.33	0.89	6.56	1.00	6.40		
	1900	0.60	6.40	0.93	6.24	1.01	6.24		

\* Electronic problems

(Continued)

Table 3: Wave Data

Jan 1992

Day	Hour	645		625		111		630	
		Baylor at 7+80 Hmo,m	T,sec	Baylor at 18+60 Hmo,m	T,sec	Pressure Gage Hmo,m	T,sec	Offshir Wvdr Hmo,m	T,sec
17	0100	0.28	5.69	0.60	6.56	0.65	6.40		
	0700	0.25	7.53	0.33	8.53	0.38	8.53		
	1300			Hardware Error					
18	1900	0.22	7.76	0.33	7.31	0.33	7.31		
	0100	0.24	7.76	0.22	7.31	0.29	7.11		
	0700	0.56	4.27	0.51	3.82	0.44	3.94		
	1300	0.45	3.82	0.48	3.88	0.47	14.22		
19	1900	0.33	4.92	0.50	4.66	0.49	5.33		
	0100	1.02	4.49	1.10	4.27	1.02	4.34		
	0700	1.59	6.56	1.67	6.24	1.84	6.56		
	1300	0.99	4.83	1.22	7.11	1.25	6.24		
20	1900	0.95	6.09	1.03	6.56	1.08	6.56		
	0100	0.48	4.83	0.72	6.24	0.73	6.40		
	0700	0.45	5.33	0.58	6.24	0.53	5.95		
	1300	0.17	8.26	0.29	8.26	0.34	9.48		
21	1900	0.21	8.83	0.25	8.26	0.26	8.53		
	0100	0.16	5.12	0.23	10.67	0.24	9.48		
	0700	0.31	3.61	0.37	3.56	0.31	3.71		
	1300	0.19	5.12	0.27	5.22	0.29	5.45		
22	1900	0.22	5.12	0.24	6.09	0.22	5.12		
	0100	0.28	4.66	0.26	5.02	0.26	5.22		
	0700	0.22	7.11	0.23	6.74	0.22	7.11		
	1300			Hardware Error					
23	1900	0.86	4.83	1.02	5.12	0.95	5.33		
	0100	0.37	5.02	0.85	5.95	0.84	5.45		
	0700	1.05	6.92	0.92	7.11	0.95	6.74		
	1300	1.34	8.26	1.28	8.00	1.45	8.00		
24	1900	1.71	9.14	1.62	9.48	1.83	9.14		
	0100	1.41	10.67	1.26	10.67	1.36	11.13		
	0700	0.89	10.67	0.90	10.67	0.99	10.67		Gage Inoperative
	1300	0.53	10.67	0.70	11.13	0.63	11.13		
25	1900	0.55	9.85	0.64	10.24	0.72	10.24		
	0100	0.90	5.33	0.89	4.57	1.02	12.80		
	0700	0.60	4.57	0.81	11.13	0.80	11.13		
	1300	0.33	10.24	0.66	13.47	0.68	11.13		
26	1900	0.50	10.24	0.66	12.19	0.64	12.19		
	0100	0.34	10.67	0.44	12.80	0.49	12.19		
	0700	0.50	3.66	0.62	3.56	0.58	3.24		
	1300	1.70	6.40	1.72	6.56	1.93	6.56		
27	1900	0.88	4.92	1.09	6.09	1.21	6.40		
	0100			Hardware Error					
	0700								
	1300	0.42	17.07	0.79	6.74	0.81	6.56		
28	1900	0.41	16.00	0.70	6.56	0.76	8.83		
	0100	0.58	16.00	0.69	16.00	0.71	8.53		
	0700	0.34	4.83	0.67	7.76	0.70	15.06		
	1300	0.73	5.33	0.87	4.06	0.83	15.06		
29	1900	0.58	4.06	1.15	5.33	1.18	5.12		
	0100	1.02	4.83	1.33	6.24	1.32	5.69		
	0700	0.77	5.57	1.19	5.57	1.26	6.09		
	1300	0.66	5.69	1.14	8.53	1.16	6.24		
30	1900	0.36	4.41	0.87	9.14	0.94	8.83		
	0100	0.58	8.83	0.97	8.53	0.98	8.26		
	0700	0.47	12.80	0.71	9.48	0.85	12.80		
	1300	0.28	12.80	0.68	8.53	0.75	12.19		
31	1900	0.26	12.80	0.60	13.47	0.66	12.19		
	0100	0.27	13.47	0.54	10.24	0.57	12.80		
	0700	0.37	8.26	0.43	13.47	0.46	13.47		
	1300	0.16	8.53	0.40	12.80	0.42	13.47		
	1900	0.83	3.66	0.84	3.77	0.69	3.66		
	Mean	0.71	7.97	0.97	8.56	1.02	8.70		
	Std dev	0.46	3.15	0.69	2.84	0.76	2.91		

\* Electronic problems

(Sheet 2 of 2)

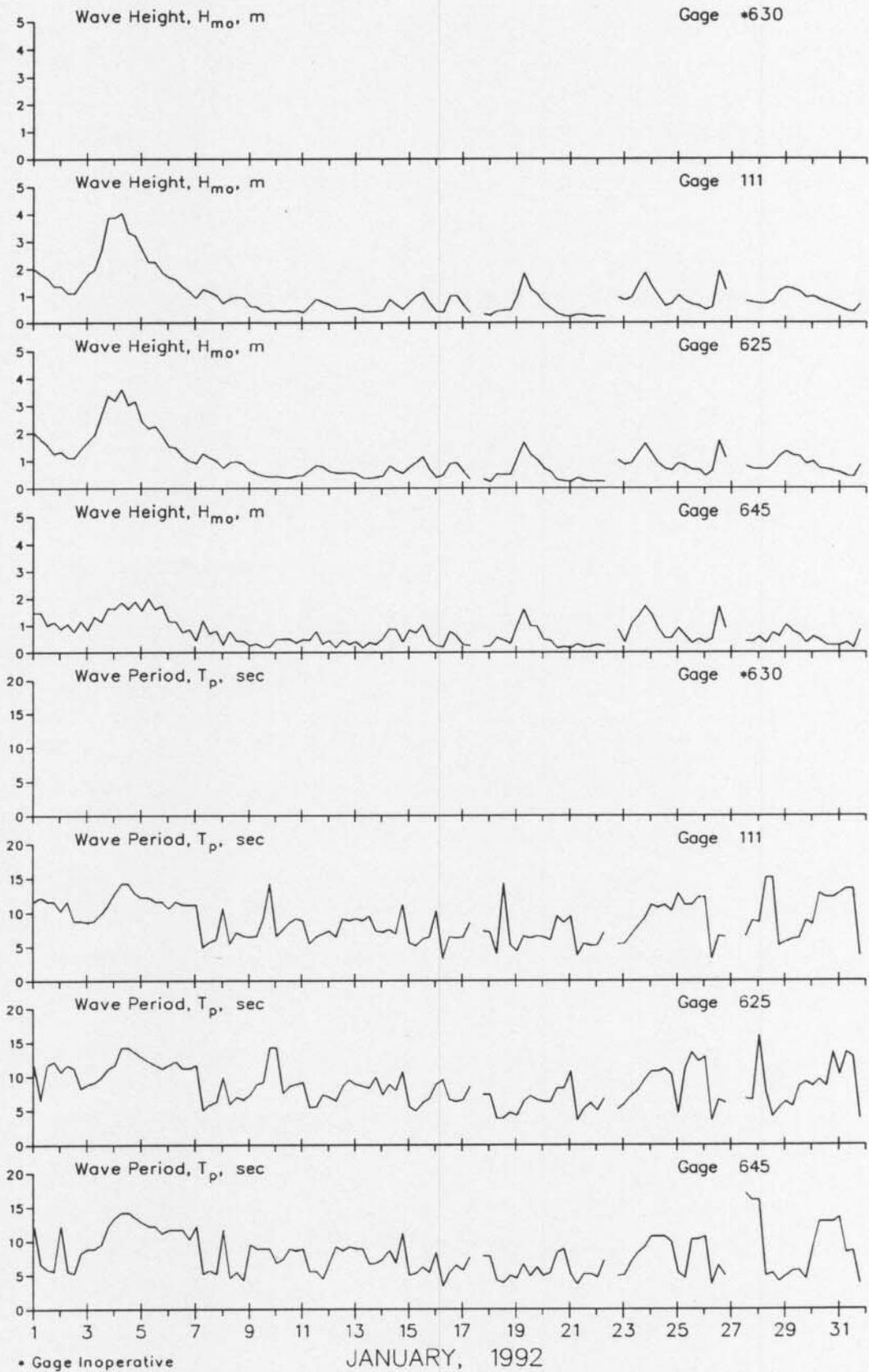


Figure 3. Time history of wave heights and periods

#### PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data  
Jan 1992

Day	Time	Alongshore Cross-shore Resultant ---- Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Dye 12m offshore (surface) Speed	Dir	Speed
1	0100	Along Cross Result								34	S
										9	off
										35	145
1	0700	Along Cross Result	44 0 44	S	177	68 0 68	S	North	33	S	32 14 35
1	1300	Along Cross Result								23	S
										10	off
										25	136
1	1900	Along Cross Result								24	S
										8	off
										25	141
2	0100	Along Cross Result								22	S
										5	off
										22	146
2	0700	Along Cross Result	17 3 18	S off	165	51 5 51	S off	North	18	S	8 6 10
2	1300	Along Cross Result								12	S
										9	off
										15	125
2	1900	Along Cross Result								12	S
										7	off
										14	129
3	0100	Along Cross Result								21	S
										6	off
										22	144
3	0700	Along Cross Result	0 15 15	on	177	41 6 41	N on	South	11	N	17 7 18
3	1300	Along Cross Result								15	S
										8	off
										17	131
3	1900	Along Cross Result								20	N
										2	off
										20	346
4	0100	Along Cross Result								60	N
										1	on
										60	339
4	0700	Along Cross Result	30 18 36	N off	240	203 0 203	N	no observation		2	S
				11			340			9	off
										9	81
4	1300	Along Cross Result								10	S
										9	off
										13	118
4	1900	Along Cross Result								16	S
										20	off
										25	108
5	0100	Along Cross Result								29	S
										19	off
										34	126
5	0700	Along Cross Result	102 0 102	S	165	55 0 55	S	no observation		35	S
				160			160			18	off
										39	133
5	1300	Along Cross Result								48	S
										21	off
										52	137
5	1900	Along Cross Result								37	S
										14	off
										40	139

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Jan 1992

Day	Time	Alongshore Cross-shore Resultant ---- Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)			Speed	Dir
			Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed		
6	0100	Along Cross Result								30 12 33	S off 138
6	0700	Along Cross Result	12 7 13	S off 129	201	20 12 24	S off 129	no observation		16 4 17	S off 146
6	1300	Along Cross Result								9 9 13	S off 117
6	1900	Along Cross Result								12 6 13	S off 135
7	0100	Along Cross Result								10 5 11	S off 134
7	0700	Along Cross Result	41 0 41	S  160	165	55 0 55	S  160	no observation		29 14 32	S off 134
7	1300	Along Cross Result								31 13 34	S off 138
7	1900	Along Cross Result								21 7 22	S off 141
8	0100	Along Cross Result								15 8 17	S off 133
8	0700	Along Cross Result	19 0 19	S  160	152	27 0 27	S  160	North 26 s		15 9 17	S off 130
8	1300	Along Cross Result								17 9 19	S off 133
8	1900	Along Cross Result								13 4 13	S off 141
9	0100	Along Cross Result								16 2 16	S off 154
9	0700	Along Cross Result	22 10 24	N off 4	140	9 2 10	N off 354	South 10 s		6 3 6	N on 312
9	1300	Along Cross Result								4 1 4	N on 324
9	1900	Along Cross Result								11 5 11	N on 317
10	0100	Along Cross Result								2 2 3	S off 115
10	0700	Along Cross Result	8 7 11	S on 202	128	0 0 0		North 8 N		1 1 2	N off 27
10	1300	Along Cross Result								3 6 7	S off 100
10	1900	Along Cross Result								2 8 8	S off 82

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Jan 1992

Day	Time	Alongshore Cross-shore Resultant ----- Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed
11	0100	Along Cross Result								2 3 3	N on 284
11	0700	Along Cross Result	14 8 16	S off 129	152	17 10 20	S off 129	North	30 S	9 1 9	S off 153
11	1300	Along Cross Result								11 4 11	S off 141
11	1900	Along Cross Result								2 1 2	N off 357
12	0100	Along Cross Result								1 1 1	S on 202
12	0700	Along Cross Result	16 2 16	N on 334	142	0 0 0		South	3 N	6 2 7	N on 320
12	1300	Along Cross Result								1 1 2	N off 32
12	1900	Along Cross Result								6 5 7	N on 301
13	0100	Along Cross Result								4 3 5	N on 307
13	0700	Along Cross Result	28 3 28	N off 346	140	9 0 9	N 340	South	0	9 4 9	N on 318
13	1300	Along Cross Result								17 0 17	N off 340
13	1900	Along Cross Result								2 2 3	N on 292
14	0100	Along Cross Result								3 1 3	N off 0
14	0700	Along Cross Result	61 6 61	N off 346	165	87 0 87	N 340	no observation		20 5 20	N on 325
14	1300	Along Cross Result								14 13 18	N on 297
14	1900	Along Cross Result								5 2 5	N on 316
15	0100	Along Cross Result								8 1 8	S off 150
15	0700	Along Cross Result	32 3 32	S off 154	201	61 0 61	S 160	North	64 S	13 5 14	S off 138
15	1300	Along Cross Result								11 3 11	S off 143
15	1900	Along Cross Result								6 2 6	N on 320

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Jan 1992

Day	Time	Alongshore Cross-shore Resultant ----- Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed
16	0100	-Along Cross Result								19 8 20	N on 317
16	0700	-Along Cross Result	no observ		no observation			North	18 S	1 1	N on 298
16	1300	-Along Cross Result								23 6 23	S off 145
16	1900	-Along Cross Result								21 6 21	S off 143
17	0100	-Along Cross Result								5 1 5	S off 148
17	0700	-Along Cross Result	24 7 25	N off 357	140	9 10 14	N off 26	South	4 N	8 3 8	N on 319
17	1300	-Along Cross Result									
17	1900	-Along Cross Result								10 3 10	N on 323
18	0100	-Along Cross Result								13 4 14	N on 325
18	0700	-Along Cross Result	12 0 12	S off 160	154	19 0 19	S off 160	North	8 S	4 0 4	N on 340
18	1300	-Along Cross Result								3 3 5	N off 24
18	1900	-Along Cross Result								3 2 3	N on 296
19	0100	-Along Cross Result								9 3 10	S off 140
19	0700	-Along Cross Result	87 17 89	S off 149	226	102 30 106	S off 143	North	41 S	33 12 35	S off 140
19	1300	-Along Cross Result								28 10 29	S off 141
19	1900	-Along Cross Result								25 10 27	S off 138
20	0100	-Along Cross Result								13 5 14	S off 137
20	0700	-Along Cross Result	0 9 9	off 70	140	0 9 9	off 70	North	5 N	0 3 3	off 70
20	1300	-Along Cross Result								8 1 8	N on 331
20	1900	-Along Cross Result								0 3 3	off 70

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Jan 1992

Day	Time	Alongshore Cross-shore Resultant ----- Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed
21	0100	-Along Cross Result								13 6 15	S off 136
21	0700	-Along Cross Result	0 12 12	off 70	140	0 3 3	off 70	North	2 S	3 1 3	S 160
21	1300	-Along Cross Result								4 1 4	S on 178
21	1900	-Along Cross Result								2 2 2	N on 297
22	0100	-Along Cross Result								15 5 16	S off 141
22	0700	-Along Cross Result	8 0 8	S 160	128	0 0 0	0	North	4 S	7 3 7	S off 138
22	1300	-Along Cross Result									
22	1900	-Along Cross Result								15 6 16	S off 139
23	0100	-Along Cross Result								19 9 21	S off 134
23	0700	-Along Cross Result	15 0 15	S 160	165	51 0 51	N 340	South	64 N	17 8 18	S off 135
23	1300	-Along Cross Result								17 4 18	N on 328
23	1900	-Along Cross Result								9 13 16	N on 286
24	0100	-Along Cross Result								1 9 9	N on 258
24	0700	-Along Cross Result	0 11 11	off 70	140	0 12 12	off 70	North	16 N	12 8 15	N on 306
24	1300	-Along Cross Result								9 4 9	N on 318
24	1900	-Along Cross Result								7 2 7	N on 327
25	0100	-Along Cross Result								16 6 17	S off 139
25	0700	-Along Cross Result	0 2 2	off 70	165	17 4 18	S 146	North	17 S	2 3 3	N on 280
25	1300	-Along Cross Result								19 1 19	N off 344
25	1900	-Along Cross Result								26 7 27	N on 324

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Continued)  
Jan 1992

Day	Time	Alongshore Cross-shore Resultant ----- Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519		
			Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed	Dir
26	0100	Along Cross Result									15 4 16	N on 325
26	0700	Along Cross Result	51 0 51	S  160	175	76 0 76	S  160	no observation			1 0 1	S  160
26	1300	Along Cross Result									45 15 47	S off 142
26	1900	Along Cross Result									32 12 34	S off 139
27	0100	Along Cross Result										
27	0700	Along Cross Result	8 0 8	S  160	213	10 6 12	S off 129	North	8	S		
27	1300	Along Cross Result									11 10 15	S off 118
27	1900	Along Cross Result									7 4 8	S off 132
28	0100	Along Cross Result									6 1 6	S off 147
28	0700	Along Cross Result	20 6 21	S on 177	177	3 2 4	S on 191	North	20	N	14 14 20	S off 115
28	1300	Along Cross Result									21 10 24	S off 134
28	1900	Along Cross Result									34 13 36	S off 140
29	0100	Along Cross Result									39 13 40	S off 142
29	0700	Along Cross Result	34 0 34	S  160	201	61 0 61	S  160	North	21	S	31 11 33	S off 140
29	1300	Along Cross Result									23 1 23	S off 158
29	1900	Along Cross Result									22 7 24	S off 142
30	0100	Along Cross Result									4 5 7	N on 288
30	0700	Along Cross Result	6 7 9	N off 30	177	0 0 0	0 0 0	South	14	N	3 2 4	S off 127
30	1300	Along Cross Result									12 4 12	N on 321
30	1900	Along Cross Result									8 5 10	N on 306

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Concluded)  
Jan 1992

Day	Time	Alongshore Cross-shore Resultant	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter 0.9 km Offshore Depth -5.6m (NGVD) ID #519	
			Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Dye 12m offshore (surface)			Speed	Dir
			Speed	Dir	Speed	Dir	Location	Speed	Dir	Speed	Dir
31	0100	Along Cross Result								10 6 12	N on 307
31	0700	Along Cross Result	0 9 9		152	0 5 5	off off 70	South	4 N	6 4 8	N on 305
31	1300	Along Cross Result								4 0 4	N  340
31	1900	Along Cross Result								9 7 11	S off 123

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

## PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Jan 1992

Day	Time	Wave Approach Angle at Pier End deg from True N		Radar Wave Angle deg from True N	Width of Surf Zone, m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis., m
1	0930	70	50	70	165	8.9	1.0222	0.3
2	0805	70		70	136	8.9	1.0220	0.6
3	0802	90		90	244	10.0	1.0228	0.3
4	0920	90		90	457	10.0	1.0236	0.3
5	0940	90	20	80	168	9.4	1.0238	0.3
6	0800	60	15	90	266	9.4	1.0241	0.6
7	0735	30		70	110	9.3	1.0244	0.3
8	0736	55	45	60	161	8.3	1.0239	1.2
9	0723	130	75		14	8.3	1.0238	1.5
10	0830	130			4	9.2	1.0240	1.5
11	0913	40		45	34	8.3	1.0234	1.2
12	0950	50		50	16	8.3	1.0236	1.5
13	0800	135	65		12	8.7	1.0239	1.5
14	0712	130		100	28	10.1	1.0254	0.3
15	0718	30	155	25	106	9.8	1.0257	1.2
16	0721	150	5		19	9.9	1.0260	0.3
17	0735	155		65	7	7.2	1.0260	0.6
18	0930	20		40	16	8.3	1.0260	1.5
19	0945	10		35	124	7.8	1.0261	0.9
20	0938	65	115		12	6.7	1.0261	0.9
21	0916	25	125		9	6.5	1.0257	1.5
22	0715	75			1	6.7	1.0257	1.5
23	0740	125		100	26	7.7	1.0240	3.0
24	0945	125			17	8.3	1.0260	0.9
25	0930	15		40	24	7.8	1.0256	1.5
26	0835	10		25	45	7.2	1.0257	1.2
27	0800	45	80	75	191	8.3	1.0260	1.8
28	0725	65	35	85	122	7.6		1.2
29	0730	80	40	80	171	6.7	Hydro- meter	1.5
30	0815	95	115		35	6.7		1.8
31	0820	100	85			7.8	Broken	1.8

## PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

# FRF Tide Heights

Jan 1992

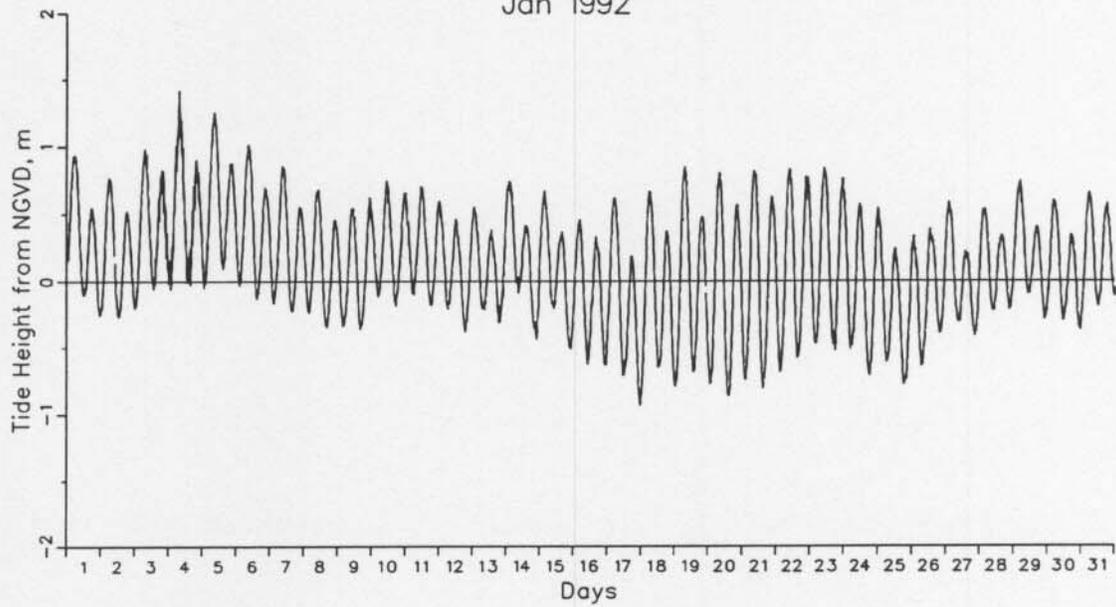


Figure 4. Water level time history

### Monthly Water Levels, m NGVD

Extreme Low = -0.94 on day 17 at 2242 EST  
Extreme High = 1.42 on day 4 at 642 EST  
Monthly Mean = 0.13  
Mean Low = -0.37  
Mean High = 0.63  
Mean Range = 1.00

Table 6: Water Levels, m NGVD

		Jan 1992			
Mid-Cycle Day	Time	Low	High	Mean	Range
1	954	-0.10	0.94	0.45	1.04
1	2219	-0.25	0.55	0.14	0.80
2	1044	-0.27	0.77	0.27	1.04
2	2309	-0.20	0.52	0.13	0.73
3	1134	-0.05	0.98	0.45	1.04
4	0	-0.06	0.83	0.37	0.89
4	1225	-0.03	1.42	0.66	1.44
5	50	-0.05	0.91	0.41	0.95
5	1315	0.09	1.26	0.68	1.16
6	140	-0.03	0.88	0.45	0.91
6	1406	-0.13	1.01	0.45	1.15
7	231	-0.16	0.70	0.27	0.86
7	1456	-0.22	0.86	0.31	1.08
8	321	-0.24	0.55	0.17	0.79
8	1546	-0.34	0.68	0.16	1.03
9	412	-0.34	0.46	0.05	0.80
9	1637	-0.36	0.54	0.09	0.90
10	502	-0.11	0.62	0.23	0.74
10	1727	-0.18	0.75	0.27	0.93
11	552	-0.10	0.66	0.28	0.76
11	1818	-0.18	0.70	0.24	0.88
12	643	-0.21	0.59	0.19	0.80
12	1908	-0.38	0.46	0.04	0.84
13	733	-0.21	0.55	0.15	0.76
13	1958	-0.31	0.38	0.05	0.69
14	824	-0.09	0.74	0.33	0.83
14	2049	-0.43	0.41	0.02	0.85
15	914	-0.20	0.67	0.22	0.88
15	2139	-0.51	0.37	-0.06	0.87
16	1004	-0.62	0.46	-0.05	1.08
16	2229	-0.63	0.33	-0.14	0.96
17	1055	-0.71	0.62	-0.01	1.33
17	2320	-0.94	0.19	-0.35	1.12
18	1145	-0.65	0.67	0.02	1.32
19	10	-0.79	0.37	-0.21	1.16
19	1235	-0.68	0.85	0.10	1.53
20	101	-0.77	0.48	-0.13	1.25
20	1326	-0.86	0.80	-0.01	1.67
21	151	-0.74	0.57	-0.09	1.31
21	1416	-0.80	0.82	0.05	1.62
22	241	-0.68	0.63	-0.02	1.31
22	1507	-0.58	0.84	0.13	1.41
23	332	-0.47	0.78	0.15	1.25
23	1557	-0.52	0.84	0.18	1.36
24	422	-0.51	0.77	0.12	1.28
24	1647	-0.71	0.57	-0.06	1.28
25	513	-0.61	0.54	-0.05	1.15
25	1738	-0.78	0.24	-0.26	1.02
26	603	-0.64	0.34	-0.17	0.98
26	1828	-0.39	0.38	-0.02	0.78
27	653	-0.31	0.59	0.13	0.90
27	1919	-0.41	0.22	-0.08	0.63
28	744	-0.22	0.54	0.16	0.76
28	2009	-0.21	0.34	0.07	0.55
29	834	-0.09	0.74	0.32	0.84
29	2059	-0.28	0.40	0.08	0.69
30	925	-0.30	0.60	0.18	0.90
30	2150	-0.37	0.34	-0.01	0.71
31	1015	-0.19	0.66	0.23	0.84
31	2240	-0.11	0.58	0.22	0.69

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Geodimeter surveying system; a Geodimeter 140-T self-tracking, electronic theodolite, distance meter, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in December 1991 and the three surveys in January 1992 on profile line 188, located 517 m south of the pier. Significant changes to the profile include a 60 m seaward migration of the offshore bar (240 - 400 m) and a 20 m seaward shift of the nearshore bar (140 - 160 m). Only minor changes are visible on the remainder of the profile.

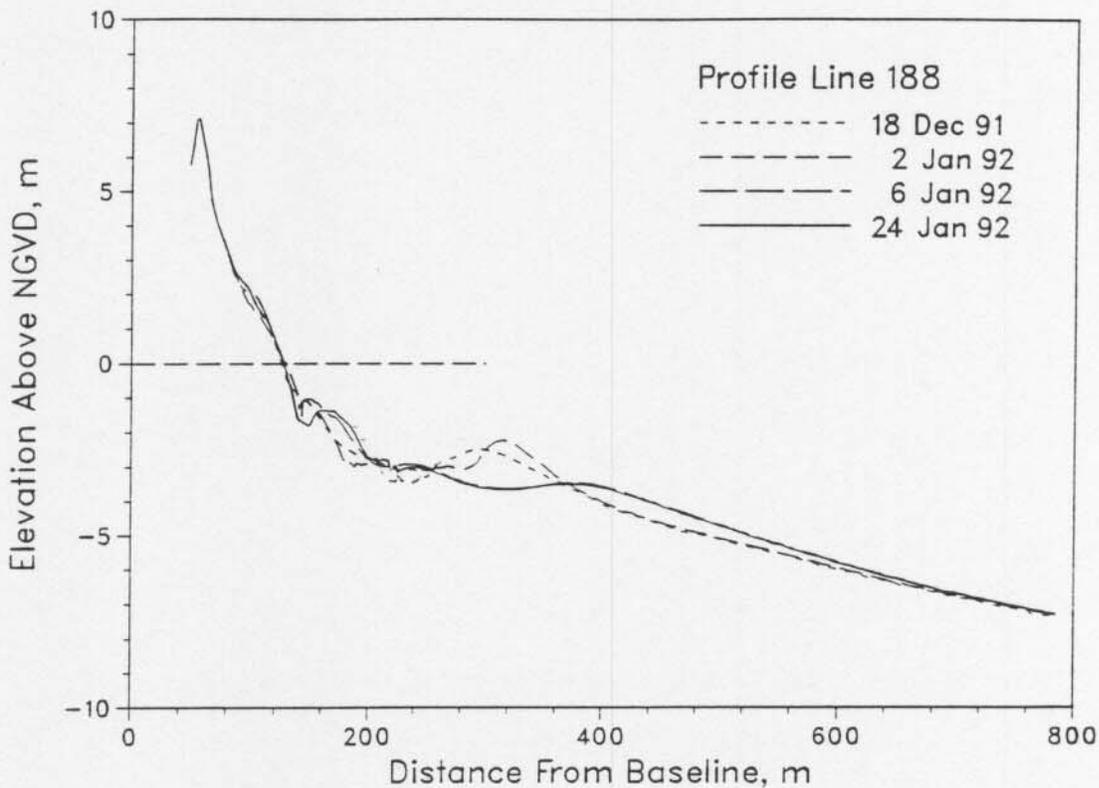


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1992.

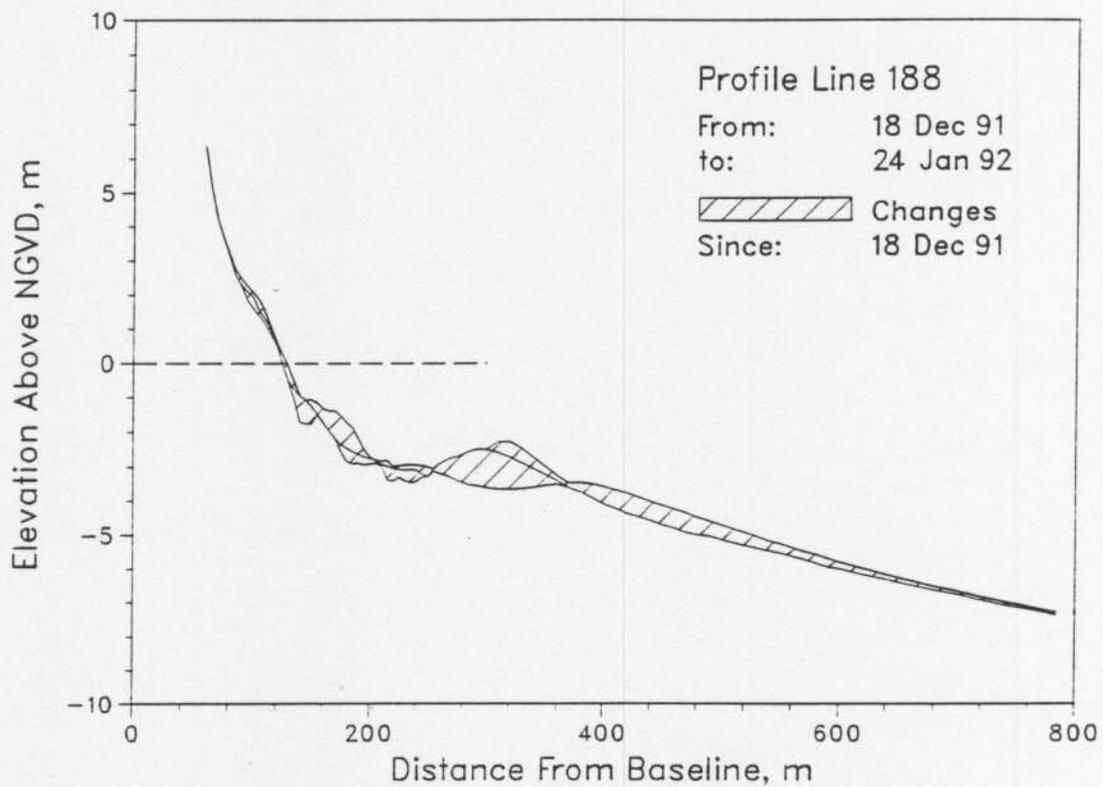


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 18 January. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

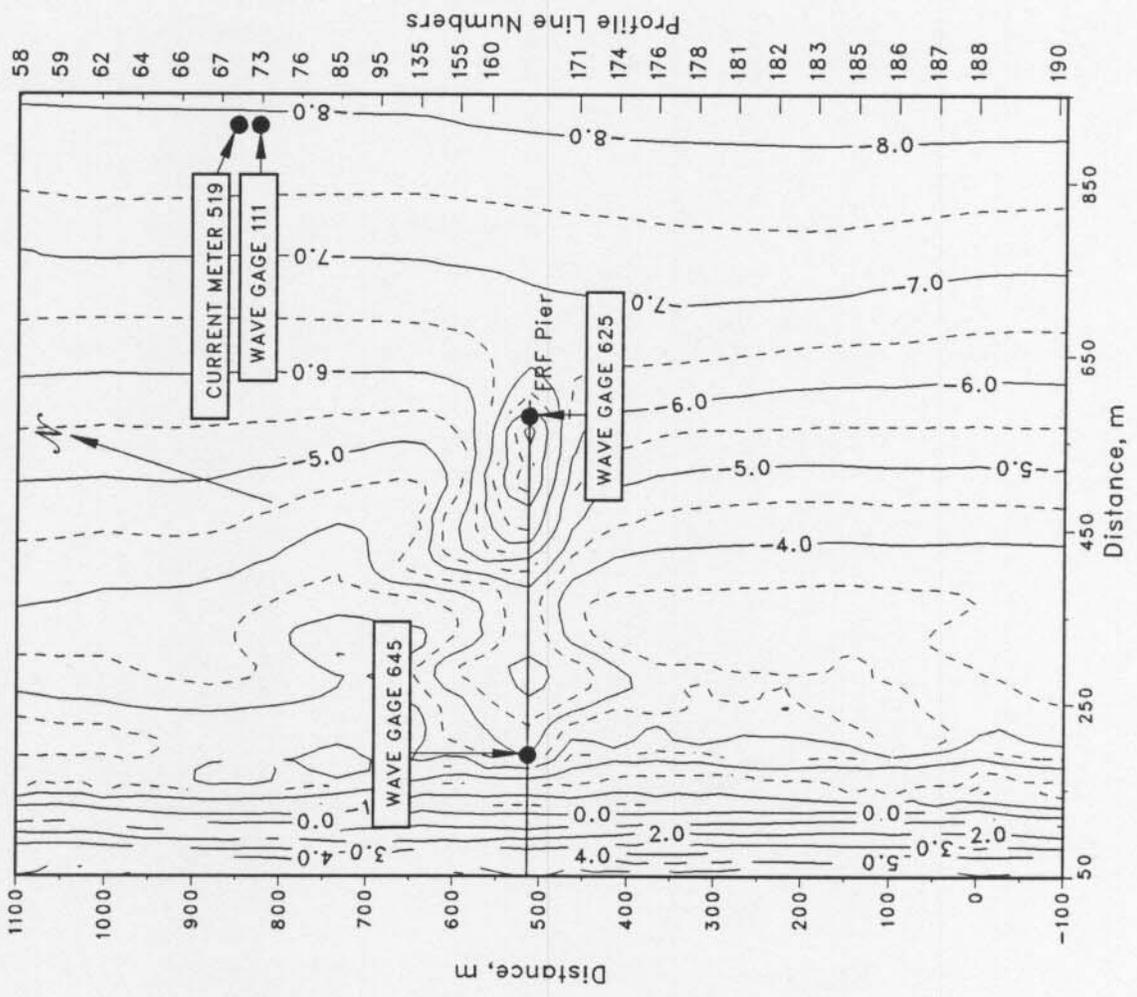
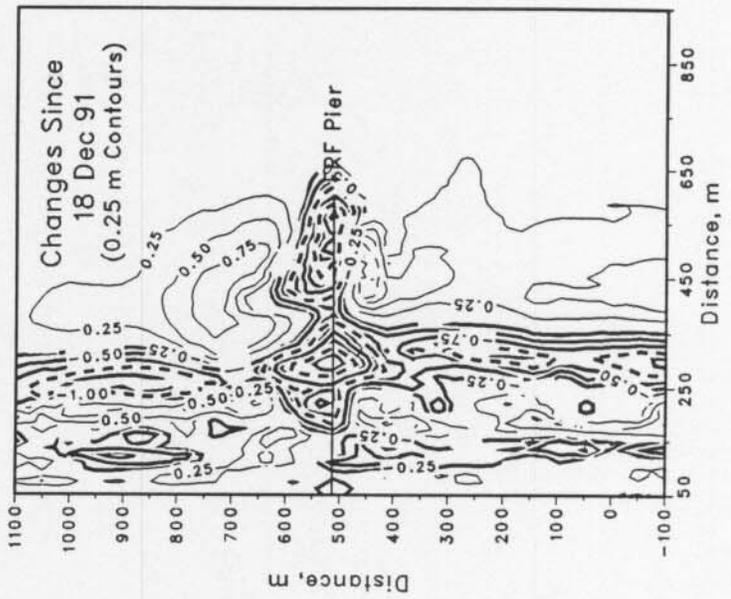
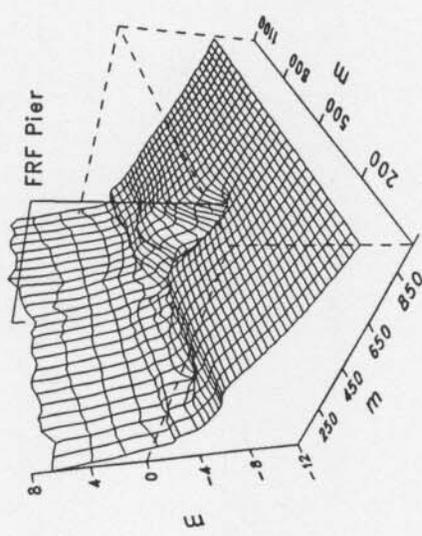


Figure 7. FRF bathymetry 24 Jan 92 depths relative to NGVD

## PART VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the significant wave height at the seaward end of the pier (i.e. as measured near the end of the pier) exceeded 2 m and four contiguous 34 minute wave records were obtained every three hours:

<u>Start</u>	<u>End</u>
3 Jan (1034)	5 Jan (1634)

### B. Storm Synopsis.

On 2 January, late in the day, a low pressure system formed off the eastern Florida coast. By 3 January, the storm made landfall on the South Carolina coast. On 4 January, the storm reformed off South Carolina and proceeded north, along the coast, toward New England. The maximum  $H_{m0}$  (at gage 111) of 4.3 meters ( $T_p = 13.5$  sec) was attained at 0508 EST on 4 January. Maximum winds (from northeast) reached 12.5 m/s on 3 January at 1742 EST. Total precipitation was 45 mm.

Distribution List

Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
SAW	U.S. Naval Research Lab

Colleges/Universities:

California Inst. of Tech.	Stockton State College
East Carolina University	University of Akron
Florida Inst. of Tech.	University of Delaware
Harvard University	University of Florida
Naval Post Graduate School	University of Maryland
NC State University	University of Miami
Old Dominion University	University of North Carolina
Oregon State University	University of N. Colorado
Prince George's College	University of Rhode Island
Rutgers University	University of Virginia
Scripps Inst. of Oceanography	Va. Inst. of Marine Science
Southern Illinois University	

Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
Coastal and Est. Res., Inc.	Offshore Coastal Technologies
Coastal Science & Eng., Inc.	Mr. Rowland
Dr. Galvin	Mr. Savage
GEOMET Tech., Inc.	Sea Port Supply Corp.
Greenhorne & O'Mara, Inc.	Shell Development
Dr. Hylton	Sherwood Industries
Mary Marr, Inc.	Mr. & Mrs. Valpey
Mr. Mason	WCTI-TV
Masonite Corporation	SEASUN Power Systems

Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)  
Queen's University, Ontario (Canada)  
Ministry of Construction, Coastal Division (Japan)  
Norwegian Hydrodynamic Laboratories (Norway)  
University of New South Wales (Australia)  
University of Sydney (Australia)